

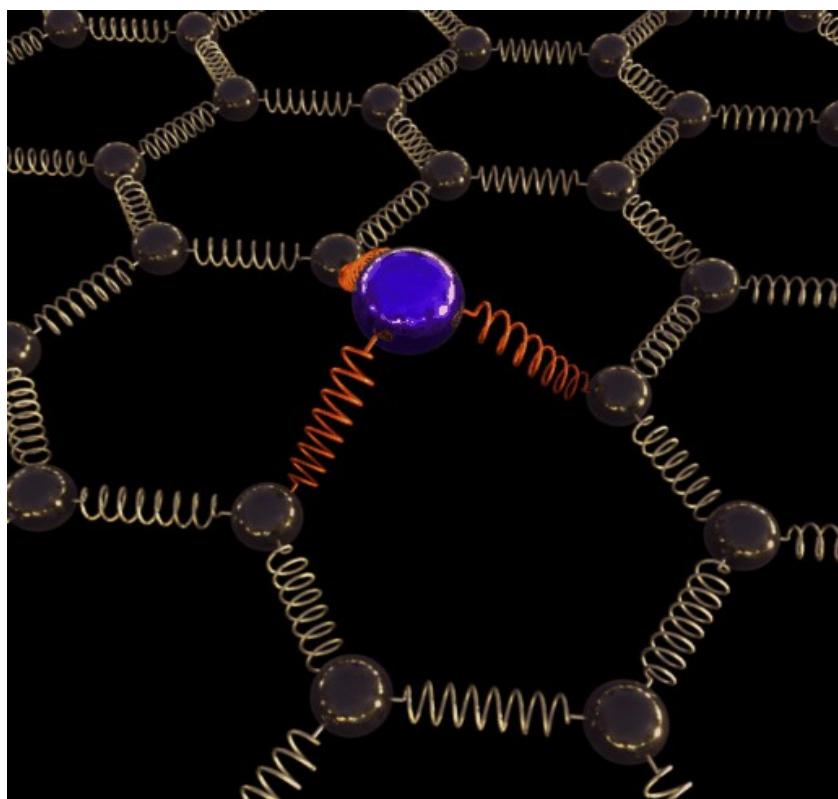
## Does dark matter really exist?

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No, it doesn't exist. Its existence is contrary to quantum mechanics. More precisely, quantization of energy according to Planck. This can easily be proved using organic chemistry (infrared spectroscopy) and quantum mechanics. Let's consider it in more detail.

On Phys.org - News and Articles on Science and Technology article appeared «'Tickling' an atom to investigate the behavior of materials» [1], in which it is popularly said that one foreign silicon atom in the graphene lattice can change its vibrational properties. That is, in fact, scientists were able to register a change in the vibrational energy of an individual silicon atom! I especially note when absorbing an energy quantum (energy quantization is an indisputable fact)!

«Quentin Ramasse, Professor of Advanced Electron Microscopy at Leeds who led the project, said: "We now have direct evidence that a single "foreign" atom in a solid can change its vibrational property at the atomic scale. ...The findings, Single Atom Vibrational Spectroscopy in the Scanning Electron Microscope, are published today in the journal Science...» [1, 2]. The illustration of this miracle is simply incomparable! See picture (The animation shows the vibration energy of the silicon atom in the graphene crystal. Credit: D. Kepaptsoglou, SuperSTEM) [1].



Remember, that:

«Simplified, a chemical bond can be considered as a spring with a certain stiffness. This spring stiffness is the multiplicity of the chemical bond. The stronger the chemical bond, the greater the multiplicity of the bond, that is, the stronger our spring will be. This analogy is directly confirmed by infrared spectroscopy, which allows you to determine the multiplicity of bond by the frequency of oscillations of this bond. In IR spectroscopy, chemical bonds of different multiplicities have characteristic vibration frequencies (meaning that from the IR spectrum, it is easy to distinguish between bonds with different multiplicities (1, 2, 3)...

That is, the multiplicity of the chemical bond can be considered as the force that holds the atoms (when the chemical bond formed). Obviously, with the addition of each subsequent electron, this force increases in direct proportion (each electron makes the same contribution). This force can be considered as a specific analogue of the Hooke force ( $F = -k * \Delta x$ )...» [3].

Indeed, look at molecular vibrations [4]:

"Perhaps surprisingly, molecular vibrations can be treated using Newtonian mechanics to calculate the correct vibration frequencies. The basic assumption is that each vibration can be treated as though it corresponds to a spring. In the harmonic approximation the spring obeys Hooke's law: the force required to extend the spring is proportional to the extension. The proportionality constant is known as a force constant,  $k''$ .

In quantum mechanics (as in classical mechanics), the potential energy of a harmonic oscillator is a quadratic function of the normal coordinate. The following values of the vibrational energy are possible from the solution of the Schrödinger equation [4]:

$$E = h * (n + \frac{1}{2}) * v$$

where  $v = (1/(2\pi)) * (k/m)^{0.5}$

where  $n$  - is a quantum number that takes the values 0, 1, 2, etc.

$h$  — is the Planck constant;

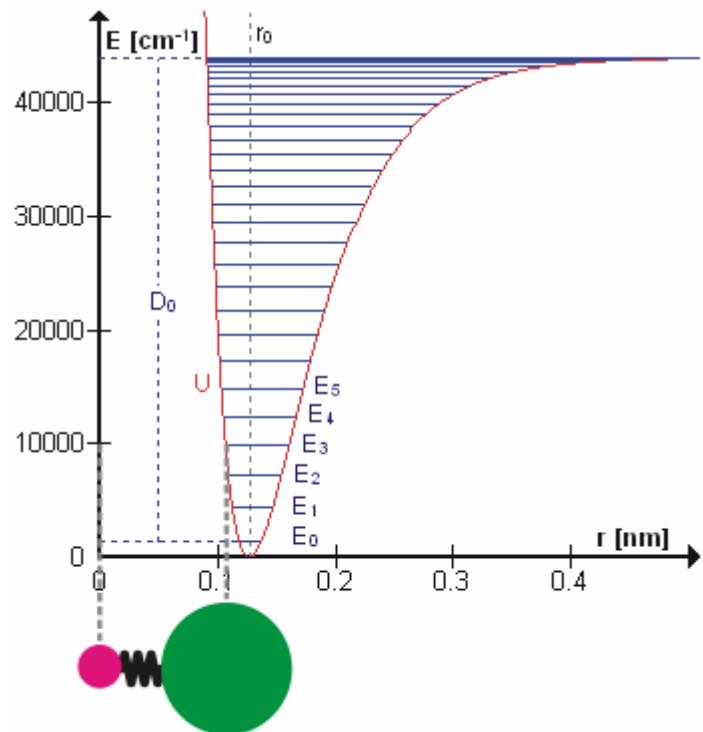
$v$  — is the frequency of vibration of the chemical bond;

$k$  — is the force constant of chemical bond vibrations; this is  $k$  from Hooke's law ( $F = -k * \Delta x$ );

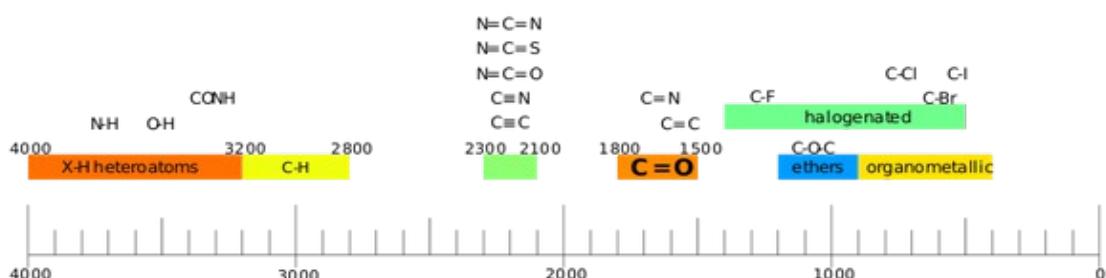
$m$  — is the reduced mass of the system (chemical bond).

To demonstrate that a chemical bond is an vibrational system, we give a picture of the vibrational diagram of a molecule H-Cl.

«The HCl molecule as an anharmonic oscillator vibrating at energy level E3. D<sub>0</sub> is dissociation energy here, r<sub>0</sub> bond length, U potential energy. Energy is expressed in wavenumbers. The hydrogen chloride molecule is attached to the coordinate system to show bond length changes on the curve» [4].



Note that the presence of certain chemical bonds in the molecule leads to the absorption of radiation of a certain frequency (characteristic frequency). This makes it possible to attribute a specific absorption band to a specific functional group. Here is a table that allows you to determine the multiplicity of chemical bonds by infrared spectrum of an organic molecule [5].



(List of main IR spectroscopy bands. For example, the carboxyl group will contain a C = O band at 1700 cm<sup>-1</sup> and an OH band at 3500 cm<sup>-1</sup> (total group -COOH). Wavenumbers listed in cm<sup>-1</sup>).

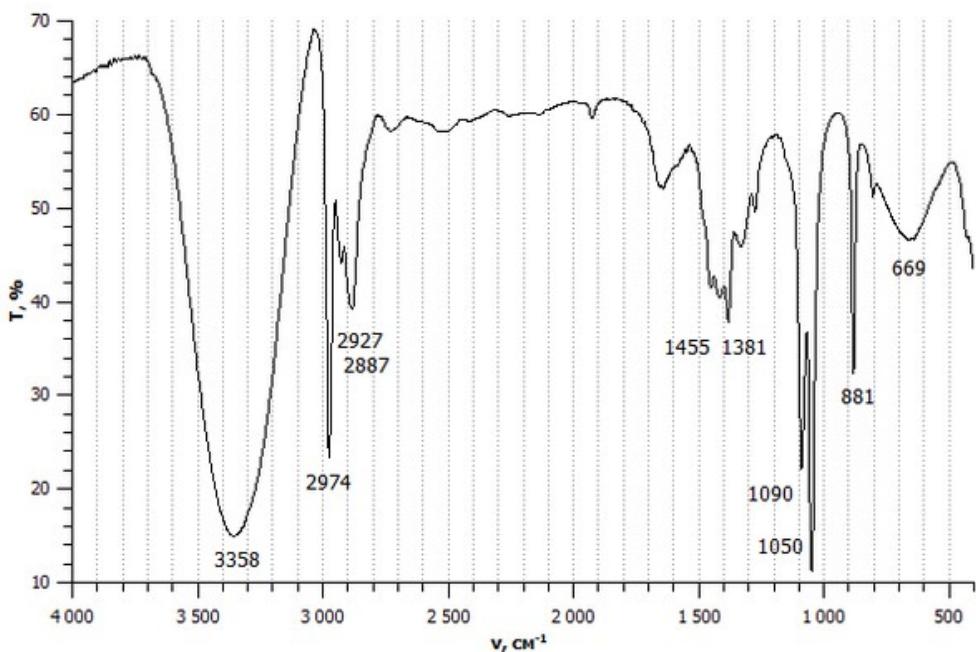
From the sheet clearly shows that if the chemical bond multiplicity is 2, then absorption bands are observed in the region of 1600 — 1800 cm<sup>-1</sup>. If the chemical bond multiplicity is 3,

then absorption bands are observed in the region of  $2100 - 2300 \text{ cm}^{-1}$ .

In the general case, the infrared spectrum (of an organic molecule) can be divided into four areas:

1. The range of vibrations of double bonds ( $1600-1800 \text{ cm}^{-1}$ ).
2. The region of vibration of triple bonds ( $2100 - 2300 \text{ cm}^{-1}$ ).
3. The region of stretching vibrations of X – H bonds ( $2800 - 3600 \text{ cm}^{-1}$ ).
4. The “fingerprint” region of the organic molecule (below  $1500 \text{ cm}^{-1}$ ).

The sheet of characteristic frequencies in infrared spectroscopy is available at links [6, 7]. A typical infrared spectrum of an organic molecule (ethanol molecule) is depicted in the figure [5, ru].



We emphasize that the region in the IR spectrum, which is called the “fingerprint region”, is a literally unique region of the spectrum that uniquely identifies this molecule. The “fingerprint” region contains vibrations that characterize the molecule as a whole (rather than vibrations of certain chemical bonds), and therefore, this region is unique for each molecule.

That is, if we look at the spectrum below  $1500 \text{ cm}^{-1}$ , then this pattern of the spectrum will be observed only in a specific molecule (the only one in our Universe!). That is, these are really fingerprints of organic molecules. Therefore, the identification of organic molecules by IR spectra is not difficult: you just need to (in two different spectra) compare the area of “fingerprints”, if these areas are different, then we have different molecules. If the regions are identical, then we have the same molecules. Organic chemists do just that, for a very long time...

It is also worth noting that, theoretically, the infrared spectrum of an organic molecule “contains” complete information about this molecule. Literally, all the information about the molecule! Therefore, if it is possible to strictly calculate the chemical bond analytically, then undoubtedly this will enable from the IR spectrum to unequivocally obtain complete information about the molecule (chemical bond lengths, chemical bond energies, angles, dipole moments, etc.). That is, without X-ray analysis, we will have a complete picture of the structure of the molecule, its properties, etc. With this calculation, the synthesis of organic substances will no longer be necessary...

At the moment, a strictly analytical calculation of the chemical bond is impossible if there are two or more electrons. That is, if we have a chemical bond. In my opinion, very original!!! If we have at least one chemical bond (two-electron), then strictly theoretically it (chemical bond) cannot be calculated!

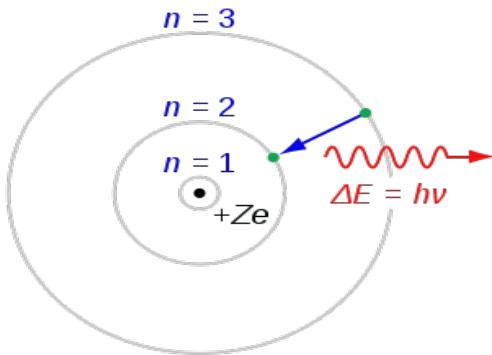
And modern approximate calculations of molecules is the art of giving a certain integral “by hand” the necessary value (previously known)... And yes, there are tens of millions of such integrals... Therefore, powerful computers are needed for quantum-chemical calculations... We can conclude that at the moment, more than a person knows artificial intelligence about chemical bonding, and this has been going on for about 50 - 70 years...

The question may arise: what does the foregoing have to do with dark matter? Answer: direct! But in order for the presentation to be logical, we need to recall the birth of quantum mechanics.

So, in 1900, Max Planck made one of the greatest discoveries in science, he introduced the quantization of energy in physics, according to the formula:

$$E = h * \gamma$$

Further, the young Niels Bohr in 1913 applied the idea of energy quantization to the planetary atom model of Ernest Rutherford (Rutherford published the work in 1911) [8].



This was a key event for the development of quantum mechanics. But, there is one caveat: since an electron and a proton have charges in a hydrogen atom, the radiation and absorption of electromagnetic radiation (energy quantum) can be intuitively associated with charges (electron, proton). But, this is fundamentally wrong!

To complicate the situation, the transition of electrons to higher (or lower) energy levels in atoms is studied by atomic spectroscopy. And ultraviolet spectroscopy studies the transitions of electrons to higher (or lower) energy levels in organic molecules. In such a situation, it is very difficult to "separate" electromagnetic radiation from charges (electron, proton) (in the historical aspect, events also developed: atomic, ultraviolet, etc.). Moreover, electromagnetic radiation has vectors of electric and magnetic fields ( $E$ ,  $H$ ). But, nevertheless, this is so: the absorption and radiation of electromagnetic radiation in quantum interactions has nothing to do with charges. Electromagnetic radiation is a universal form of energy, it is used when you need to "add" or "take away" a portion of energy (quantum). This is the only wave we know that does not need a medium for propagation. Therefore, taking into account de Broglie wave-particle duality and Einstein's theory of relativity, in quantum systems, the radiation of "excess" energy will always occur in the form of electromagnetic radiation.

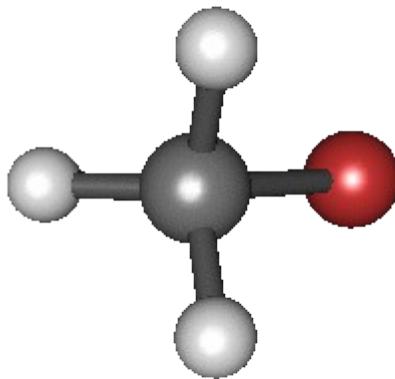
Consider that an electromagnetic wave has such "advantages":

1. The maximum speed of propagation in a vacuum (it will "add" or "carry away" energy in quantum processes as quickly as possible).
2. She does not need a propagation medium (in quantum interactions, a propagation medium cannot be by definition).
3. By changing the frequency of the wave, it can carry away virtually any portion of energy.

Moreover, the upper and lower limits are theoretically unlimited.

Given all this, it is obvious that only electromagnetic radiation can be such a "universal" energy quantum for quantum interactions. This is confirmed by infrared spectroscopy. That is, spectroscopy that studies the vibrational spectra of molecules (mainly organic molecules). Let us briefly describe it.

In all molecules, atoms make various vibrations, see the 3D animation of the symmetric stretching of the C–H bonds of bromomethane [5].



Naturally, the energy of these oscillations is quantized according to Planck, that is, according to the formula

$$E = h * \gamma$$

We emphasize that during the vibrations of atoms in molecules, energy is absorbed and radiated in the form of electromagnetic radiation by the molecule as a whole. In this case, the electrons no longer move to higher (or lower) energy levels (as was the case in atomic or ultraviolet spectroscopy). Therefore, electromagnetic radiation can no longer be associated with charges, and their transitions to levels. Simply, a molecule as an oscillatory system absorbs or radiates a quantum of energy, which is not surprising, since energy should always be quantized.

Therefore, the very existence of infrared spectroscopy is a clear confirmation of the fact that the absorption and emission of electromagnetic radiation (in quantum interactions) has nothing to do with charges. Electromagnetic radiation is simply a “convenient” form of energy that allows you to quantize energy according to given conditions (quantum conditions). As in the above work, when it was possible to register a change in the vibrational energy of an individual silicon atom!

A simple conclusion follows from this: if dark matter existed, then there would have been a quantization of energy according to Planck. That is, there would be elementary particles of dark matter, atoms of dark matter, molecules of dark matter, etc. And this means that when the particles of dark matter interact with each other, energy would inevitably be absorbed and emitted. From the foregoing, it is obvious that such energy would be emitted in the form of electromagnetic radiation. And since dark matter is such a form of matter that is inaccessible to direct observation (since it does not emit electromagnetic waves by definition), this means that dark matter does not exist.

Considering the above, and the fact that when merging black holes, energy is carried away by gravitational waves, we can conclude: gravitational waves are electromagnetic waves of giant

length. Therefore, the speed of gravitational waves is equal to the speed of light in a vacuum. The length of such "electromagnetic waves" has truly cosmological scales - these are sizes comparable to solar systems and galaxies, that is, from a few light minutes to thousands and millions of light years. Note that the idea of equivalence of gravitational and electromagnetic waves is already encountered in the literature [10].

If gravitational waves are ultra-long electromagnetic waves, then it is probably possible to improve and simplify installations for recording such waves. All the same, it is easier to work with radio waves than with classical gravitational waves...

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